DEPARTMENT OF COMMERCE

TECHNICAL NEWS BULLETIN
OF THE BUREAU OF STANDARDS

Subscription, 25 cents a year. Address "Superintendent of Documents, Government Printing Office, Washington, D. C."

Washington, June, 1925—No. 98

CONFERENCE ON WEIGHTS AND MEASURES

The Eighteenth National Conference on the Weights and Measures of the United States was held at the bureau on May 25, 26, 27, and 28. Delegates from 20 States and the District of Columbia, as well as representatives of many firms manufacturing weighing and measuring appliances, were present, the attendance being a thoroughly representative one.

The opening address was delivered by Dr. George K. Burgess, director of the Bureau of Standards and president of the conference; and the Secretary of Commerce spoke at the session on May 27. Mr. Hoover's subject was the solution of industrial problems through cooperation, and he pointed out that for three years the Department of Commerce has been following in its activities the method first given a practical trial by the Weights and Measures Conference.

The usual reports of the State delegates were presented, and many matters of great importance in the weights and measures field were discussed. These included specifications and tolerances for taximeters, and methods of testing these devices; testing equipment for heavy-capacity scales, including descriptions of special apparatus developed for this purpose; the sale of ice cream by weight; and proposed tolerances for loaves of bread, where bread is sold by weight. Weights and measures conditions in the far West were discussed by William A. Dalziel, of Oregon, and R. H. Theilmann, of Arizona.

Special problems of interest to city and county officials, such as safeguarding the merchant and the regulation of peddlers and transient vendors, were considered on the second day of the conference, which was known as City and County Day.

In connection with taximeters a report was presented by Ralph W. Smith, of the bureau, which recommended three standard tests instead of the diversity of requirements which now exists in the different States. These tests are an actual road test of the taximeter, a bench test, and a separate test of the time-recording apparatus, which determines the rate charged for time elapsed while the car is waiting for passengers.

A resolution was adopted that inasmuch as insufficient discussion on the important subject of the sale of ice cream by weight had taken place at the present conference, that this be made a special order of business before the Nineteenth National Conference and that a committee be appointed to investigate and report on the subject.

The first of these conferences was held at the bureau in 1905, and, with the exception of the years 1909, 1917, and 1918, they have been held annually since that time. Although attendance is purely voluntary, the conference has come to be recognized as an excellent way to secure cooperation and uniformity in weights and measures in the different States, and as a consequence delegates were present from every section of the country.

The following officers were elected for the coming year: S. W. Stratton, honorary president; George K. Burgess, president; Thomas F. Egan, first vice president; George Warner, second vice president; F. S. Holbrook, secretary; and George F. Austin, treasurer.

48173—25

MEETING OF THE HOROLOGICAL INSTITUTE OF AMERICA

The fifth annual meeting of the Horological Institute of America took place in Washington on May 13 and 14. Doctor Burgess delivered the address of welcome at the opening session, and outlined the work which the bureau has been conducting in cooperation with the institute. The plan for certifying watchmakers has proved very successful and has undoubtedly raised the standard of the profession. Doctor Gillett, chief of the division of metallurgy, spoke of the significance of metallurgy in watchmaking, and offered the bureau's services in the solution of problems in this branch of the industry. He called attention to possible uses for the two new alloys—invar and elinvar—in watchmaking with resulting improvement in the performance of timepieces.

R. E. Gould, chief of the time section, described the testing of chronometric instruments at the bureau, while Messrs. Beij and Cordero presented an illustrated lecture on timing mechanisms in aeronautic instruments, thus calling attention to the extensive application of chronometry and the watchmaker's ingenuity in aviation.

The meeting was followed by an inspection trip through some of the bureau's laboratories.

USING MORE FUEL TO USE LESS FUEL

Tests are in progress at the bureau to determine the influence of different factors upon the starting of internal-combustion engines. Measurements are made both of the time required to start the engine and the amount of fuel used. In many of these experiments various fuel-air ratios have been employed, and the results show that, in general, it requires a longer time to start with lean mixtures than with rich ones.

The fact that with lean mixtures the engine fires after it has made several revolutions indicates that the mixture in the engine cylinder becomes richer each revolution, although the mixture delivered by the carburetor remains the same. What is of particular interest, however, is that with the very lean mixtures the total quantity of fuel which enters the engine before an explosion is obtained is greater than when richer mixtures are employed, and the engine fires after fewer revolutions. In other words, within certain limitations using more fuel per revolution makes it possible to start the engine with a smaller total quantity of fuel.

CRETE BEAMS

Reduction in the weight of hulls of concrete ships was a matter of importance during the war. Tests for the Emergency Fleet Corporation at the Bureau of Standards and at Lehigh University showed that by the use of sufficient steel reinforcement properly placed in the walls of the ship it was safe to make the shell only 4 or 5 inches thick instead of 12 or 15.

The probable value of the information in bridge and building construction as well as in ship work led the bureau to extend greatly the scope of the tests. This work has been completed and a technologic paper, Shear Tests of Reinforced Concrete Beams, is in preparation.

This paper gives results of tests on the resistance to shearing stresses of 172 reinforced concrete beams. Most of the beams were of I-shaped sections. This shape was necessary in order to provide sufficient resistance to the horizontal tensile and compressive stresses and at the same time permit the development of high shearing stresses in the webs.

The web thickness varied from 2 to 12 inches. Most of the beams had a depth of 36 inches and a span of 9½ feet, or a depth of 52 inches and a span of 16 feet. The web reinforcement consisted in most cases of loose stirrups placed vertically or at 45° with the vertical. In all cases the bars were anchored to prevent bond failure. The strength of the concrete varied in different beams from about 21,000 pounds to about 5,400 lbs./in.^{2}

One beam had a depth of 10 feet and a span of 20 feet, and after it had been loaded 40 times to an intensity of shearing stress of 727 lbs./in.^{2} it was inverted and loaded to failure at a maximum shearing stress of 1,540 lbs./in.^{2} The repetition of the load had no apparent

effect on the strength of the beam or on the stresses developed at high loads.

Very little tensile stress was developed in the web reinforcement of any of the beams before cracks appeared. Generally the cracks occurred at shearing stresses from 100 to 300 lbs./in.^{2}

The tensile stresses in the stirrups at any shearing stress were independent of the stress of the concrete. Diagonal compression failure occurred in some of the beams made from concrete of a lean mix and reinforced with vertical stirrups.

The shearing stresses, v (in pounds per square inch), in the beams are fairly well represented by the equation

$$v=(0.005+r)f$$

where r is the ratio of sectional area of the stirrup to that of the concrete reinforced by it, and f is the tensile stress (in pounds per square inch) in the stirrup. This formula applies to the beams with either vertical or inclined web reinforcement.

Where vertical and inclined tension bars were present in the web of the same beam, the stress in the inclined bars was greater than that in the vertical bars for all stresses below the yield point. The maximum load carried was about the same as if the web reinforcement had been the same in total amount, but all vertical or all inclined.

Horizontal reinforcing bars in the web reduced the effective section to such an extent as to permit failure by horizontal shear in the web.

The deflections and crack widths were greater for beams with vertical than for beams with inclined web reinforcement.

ADHESION OF MORTAR TO BRICK

Comparatively little work has been done on the adhesion of mortar to brick, although it has been recognized that the bond between mortar and brick is a factor contributing to the strength and performance of masonry. The problem, therefore, of determining the effect of various kinds of mortars for use with sand-lime brick was taken up by the bureau.

The total absorption and rate of absorption have been determined for 1,100 sand-lime bricks, so that they can be arranged in groups of different absorptive capacities. In general, bricks of the highest total absorption show the most rapid rate of absorbing water.

Tests were made with a 1:3 cement mortar, where the percentage of water was varied, both in the bricks and in the mortar. Where the bricks were used dry, the mortar adhered to the brick first in contact with it. Where the bricks were wet, the mortar adhered to the second brick. The results show that the strength of the bond between cement mortar and bricks is greater when bricks are wet rather than dry and when the mortar itself is quite wet.

PORTABLE MACHINE FOR TESTING BRICKS

A portable machine for testing bricks in cross bend has been designed by Dr. A. H. Stang, of the engineering mechanics section of the bureau, and construction is practically completed. The machine will weigh about 40 pounds. It is hydraulically operated, 16 inches high, 6 inches wide, and 12 inches long.

On account of the proposed change in the A. S. T. M. specifications for brick testing, which will probably eliminate all physical tests except the cross-bend test, the need for such a machine is evident. With this machine an inspector can test bricks on the job and will not need to send specimens to a distant testing laboratory. Delays will thus be avoided and a real indication given of the quality of the brick.

ARCHITECTURAL TERRA-COTTA INVESTIGATIONS

The National Terra Cotta Society for a number of years has been supporting a research associate at the bureau with the object of securing and maintaining a quality of architectural terra cotta which will give the best performance of this ware in buildings.

The physical properties of terra cotta have been determined, including compressive strength, transverse strength, tensile strength, resistance to freezing, and the coefficient of expansion. The tensile strength, as compared with building

stone of like absorption, was found to be high.

Investigations of the expansions of the glaze, body, and underslips have also been undertaken. The coefficients of expansion of 20 samples of each on these materials have been measured by the interferometer method. Crazing of the glaze in some cases was found to be due to the glaze having a greater coefficient of expansion than the body.

In order to study the serviceability of this ware in buildings, terra cotta which had been in service 2 to 30 years was examined critically on 535 buildings in practically every large city in the United States east of Kansas City, Mo. It was found that terra cotta must meet certain requirements in climates having freezing weather. Keeping water out of terra-cotta structures by proper flashing was found to be beneficial, especially where steel which would otherwise rust is used in the structure.

An investigation of manufacturing methods, with the object of standardizing manufacturing practices in so far as these affect the quality, included a visit to 14 terra-cotta plants. The good and poor practices employed by the different plants are being pointed out to the industry. The economic value to the public of improving the quality of the ware in this manner is inestimable.

Other research on terra cotta consists of a study of eight ceramic bodies, including four commercial terra-cotta bodies. Twelve different ceramic finishes were used on the specimens, and all of the test pieces were made at terra-cotta plants in accordance with standard practice. Outdoor service tests are being conducted on specimens molded in the shapes of balusters and coping. In addition to these, laboratory tests are being conducted on the same bodies. It was found that the methods of firing and cooling terra cotta and the types of kilns in which they are fired have a decided influence upon the quality of the ware.

Twenty cements are being investigated to determine their suitability for joining pieces of terra cotta. It was found that some of these cements produced very good joints, the most promising being those of the zinc-oxychloride type.

EFFECT OF HUMIDITY ON HARDNESS OF VARNISH

During the past month hardness measurements have been made on samples of varnish received for test in the bureau's laboratory. For this work the swinging-beam method, as described by Walker and Steele in Circular 229 of the Paint Manufacturers' Association of the United States, has been employed.

The marked effect of humidity on these measurements was brought out on a very humid day in the laboratory. For instance, a spar varnish with a drying period of two days showed a hardness factor of 0.333, the relative humidity being 50 per cent. At four days, with a humidity of 60 per cent, the hardness factor was 0.387. At six days, with a humidity of 80 per cent, the hardness factor was only 0.240, while at seven days, with a humidity of 50 per cent, the hardness factor was 0.447.

The marked decrease in hardness factor on the sixth day, when the humidity was 80 per cent, is noteworthy.

COLOR SPECIFICATION

Dr. Irwin G. Priest, chief of the colorimetry section of the bureau, delivered three lectures on the salient features and principles of the theory and practice of color specification in science, art, and industry at Massachusetts Institute of Technology on May 18, 19, and 20.

The first lecture dealt with the psychological, physical, and psychophysical data and relations of colorimetry, and their application to the color grading of materials. The subjects covered included definition, classification, and nomenclature of colors; the colorimetry problem; radiation and its sources; the spectrum, and spectral distribution of energy for incandescent solids; and the optical properties of materials.

The psychophysical relations involved in colorimetry were taken up in the second lecture. The principal subjects were the visibility of radiant energy; brilliance and brightness, hue, the quality of

color, and the spectral distribution of the stimulus; and equivalent stimuli.

The last lecture was devoted to examples of the fundamental methods and instruments used in colorimetry, illustrated by a description of the apparatus and methods in actual use at the bureau. This covered radiometry and photometry in color specifications; spectrophotometry; the colorimetry and photometry of daylight and incandescent illuminants; standard of artificial sunlight; and a synopsis of methods of color specification.

SUGGESTED DEFINITION OF NEWSPRINT PAPER

Under the present tariff regulations newsprint is the only paper allowed free entry. However, the existing definition classifying such paper has been found inadequate, as many other kinds of paper have been admitted duty free as newsprint. In view of this situation the bureau was requested by the Treasury Department to formulate a more specific definition.

Newsprint is a definite type of paper, composed of 20 per cent unbleached sulphite fiber and 80 per cent groundwood fiber; commonly weighing 32 pounds per 500 sheets 24 by 36 inches in size; containing no rosin size nor mineral filler, and having a low surface finish. To make the definition specific, the maximum allowances for these properties would necessarily have to be stated. To obtain these data samples representing the product of 11 different domestic and Canadian mills were tested. Some research was necessary to formulate satisfactory methods of determining finish and degree of sizing. For this specific purpose the Ingersoll glarimeter was found suitable for measuring the finish, and both the ground-glass method and the Valley size tester gave satisfactory results in determining degree of rosin sizing. The average test values of the samples mentioned were: Weight, 32 pounds; finish, 38.4 per cent gloss. Degree of sizing—ground glass, 2.8 seconds; Valley size tester, 1.5 seconds; ash, 0.37 per cent. Based on these results, a definition was recommended to the Treasury Department which specifies the following maximum allowances: Weight, 30 to 35 pounds, inclusive; finish, 50 per cent gloss. Degree of sizing—ground glass, 10 seconds; Valley size tester, 5 seconds; ash, 2 per cent.

In view of criticism that the test data were obtained for American-made paper only and might not be representative of that in actual use, 50 newspapers of recent date were secured for test from a local newsstand. These were selected to be as representative as possible of domestic publications, considering both geographical location and distribution of population. Twenty-six States and 46 cities were represented. Of these papers only four failed to meet the requirements of the recommended definition. One of these was a weekly publication of generally higher quality than newsprint. The other three were dailies, one being slightly overweight and two slightly exceeding the specified ash content. The average values for these papers confirmed those previously obtained, being: Weight, 32.7 pounds; finish, 36.5 per cent gloss; degree of sizing by ground-glass method, less than 5 seconds; ash, 0.69 per cent.

SPECIFICATION FOR WIRE ROPE

The most important paper in its field that has been issued in several years is Circular 208 of the Bureau of Standards, United States Government Master Specification for Wire Rope, copies of which are now on sale at the office of the Superintendent of Documents, Government Printing Office, Washington, D. C., at 15 cents each.

The paper is made up of eight major sections dealing with types, material and workmanship, general requirements, detailed requirements, inspection and tests, packing and marking, additional information, and general specifications.

It contains 28 line drawings and halftones illustrating types of rope, methods of measuring rope diameter, application of seizing, clips, and other fastenings for wire rope. The properties of the different types of rope are set forth in tables which give all the important data in very compact form.

This circular has been prepared, after careful study, by the wire-rope committee of the Federal Specifications Board, the chairman of the committee being H. L. Whittemore, of this bureau; and was officially promulgated by the board on June 1, for the use of the departments and independent establishments of the Government in the purchase of wire rope.

DENTAL AMALGAM ALLOY

The bureau has given attention to the problems encountered in securing a satisfactory alloy for dental restorations. Tests on ultimate compressional strength, flow under continued pressure, and dimensional changes upon hardening have been made. While the strength of an aged amalgam may equal that of steel when crushed quickly (as intimated by some), it is by no means similar to steel in resistance to continued pressure. All amalgams tested show continued flow when subjected to a continued pressure of only one-tenth the average quick crushing load. This means that more care must be taken in designing restorations, attachments, contact points, etc., than would be necessary if the material were similar to steel.

Dimensional change tests show slight expansions for some alloys when amalgamated and allowed to harden. Other alloys show shrinkage upon hardening. This shrinkage, which takes place during and after the insertion of the filling, is very unfortunate for both the patient and the dentist. The former does not receive the service he has a right to expect from the restoration and the latter has had his skill nullified by a defective material.

The bureau is assisting the Federal Specifications Board in the preparation of a specification for dental amalgams which will eliminate such defective materials from Government purchases.

GOLD DENTAL RESTORATIONS

The first publication of the results of work on dental gold restorations (wrought alloys) appeared in the May issue of the Journal of the American Dental Association. The bureau is conducting this research in cooperation with the Weinstein Research Laboratories of New York, N. Y. Additional articles will be published from time to time as the data are assembled. The next article will be on casting golds and techniques.

QUALITY OF CURLED HAIR

At the request of the Navy Department, the bureau recently devised apparatus for testing the quality of curled hair used for mattresses. This is an important matter when buying such material under a specification. After some study, an apparatus was outlined, consisting of a plate which rested on the mattress to be tested. The decrease in thickness of the mattress when the plate is loaded can be measured. If the load is applied and removed, repeated for a considerable time, it is believed that the readings will indicate unsatisfactory materials.

STANDARD METHOD OF MEASURING KNIT UNDERWEAR

The specifications for measurements of knitted underwear formulated by E. M. Schenke, research associate of the Associated Knit Underwear Manufacturers of America, stationed at the bureau, were adopted at the annual meeting of this association held in Atlantic City, May 15 and 16. These specifications cover the method of measurement, the measurements, and the tolerance for men's, boys', and children's 1 by 1 ribbed union suits and flat-knit union suits made from bleached cotton knitted fabric (carded yarns).

In developing these specifications questionnaires were sent to all manufacturers of each type under consideration. The information obtained covered manufacturing procedure in regard to size, together with actual measurements on a number of garments. From a collation of all these data the standard sizes were formulated. The tolerances were fixed by a measurement of over 1,000 garments to determine the variation caused by manufacturing conditions.

Several advantages are gained by the adoption of standard measurements. The primary consideration is that the same size will fit the wearer regardless of whether he buys from one manufacturer or another, and at any season of

the year. In addition, economies of manufacture will result which will benefit both manufacturer and consumer.

Space does not permit the inclusion of these standards in this bulletin, but they will be published shortly by the Associated Knit Underwear Manufacturers of America. A committee on standard procedure is being formed, and they will be put into effect for the 1926 spring season.

THERMAL CONDUCTIVITY OF LEATHER AND COMPOSITION SOLES

In connection with investigations to determine the comparative properties of leather and composition (rubber base) shoe soles, the bureau noted that greater foot discomfort appears to occur with shoes having composition soles. Since comments to this effect were more frequent in the warmer months of the year, and mentioned heating, drawing, or burning sensations of the foot, it was suggested that the difference in thermal conductivity of the two soling materials might partially account for the seeming discomfort.

To secure information on this point, a crude experiment was performed which involved placing a pair of shoes (one shoe being soled with leather and the other with composition material) on a hot plate the temperature of which was 160° F. The initial temperature inside the shoes was 84° F. The tops of the shoes were sealed with paper board through which thermometers were so placed that the bulbs were just above, but not in contact with, the soles. The temperature inside each shoe was read every minute for one hour. At the end of the hour the temperature in each shoe had risen from 84 to 120° F. This experiment indicated that there existed no appreciable difference in the rate of transfer of heat through leather and the rubber composition. More accurate measurements were then made by placing samples of the materials between metal plates, between which a constant difference of temperature was maintained by electrically heating one of the plates. The heat flow was measured by the electrical power input, and the temperature difference was measured by means of thermocouples fastened on the surfaces of the samples. The conductivities of the leather and composition were determined as being 0.00037 and 0.00038, respectively, expressed as calories per second per square centimeter per degree Centigrade per centimeter thickness.

These results show that there is no appreciable difference in the thermal conductivity of ordinary sole leather and the composition soling materials, and any difference in discomfort between the two materials must be due to some other cause.

RADIO SUNSET FADING TESTS

In special tests from March 24 to April 2, this bureau, with the cooperation of about 20 laboratories in various cities, made records of the variation in intensity of signal received from station WGY, General Electric Co., Schenectady, N. Y., during the sunset period. In order to study further the effects of sunset a second series of observations was started May 19 on station KDKA, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Records were made by an augmented group of laboratories on six days, distributed during the eriod May 19 to May 29. The observing periods were approximately three hours long, centering at the time of sunset at the receiving station. The records of these observations as well as those of the tests on WGY are being studied and a report on the characteristic effects which these observations established will be issued at a later date.

Future cooperative observations will be conducted on fading, field intensity, frequency, direction, and atmospheric disturbances. The details of successive tests will be determined to a considerable extent by the cumulative results of the completed tests. Laboratories interested in measurements of radio-wave phenomena are invited to communicate with the Bureau of Standards, Washington, D. C., relative to participation in the investigation. The apparatus required for recording signal-intensity variations can be constructed from the equipment of the average college or commercial radio laboratory. Measurements of field

intensity and direction require the construction or assembly of somewhat specialized apparatus.

PUBLICATIONS OF THE BUREAU OF STANDARDS RELEASED DURING APRIL AND MAY

Scientific Papers

S501. Specific heat of superheated ammonia vapor. N. S. Osborne, H. F. Stimson, T. S. Sligh, jr., and C. S. Cragoe. Price, 15 cents.

S502. An improved type of wave-meter resonance indicator. Morris S. Strock. Price, 5 cents.

S504. A method of studying electrode potentials and polarization. H. D. Holler. Price, 15 cents.

S505. Critical potentials associated with excitation of alkali spark spectra. F. L. Mohler. Price, 10 cents.

Technologic Papers

T272. Fire resistance of concrete columns. W. A. Hull and S. H. Ingberg. Price, 25 cents.

T279. Testing of fire-clay brick with special reference to their use in coal-fired boiler settings. F. R. Geller. Price, 20 cents.

T280. Reclamation of gasoline use in dry cleaning. C. C. Hubbard. Price, 5 cents.

T281. Malleability and metallography of nickel. P. D. Merica and R. G. Waltenberg. Price, 10 cents.

T282. Technology of cotton machinery, part 1—Calculations on pickers. A. A. Mercier. Price, 10 cents.

T283. Effect of tire resistance on fuel consumption. W. L. Holt and P. L. Wormeley. Price, 5 cents.

T284. A study of the seasonal variation of radio-frequency phase difference of laminated phenolic insulating materials. J. L. Preston and E. L. Hall. Price, 5 cents.

Circulars

C95. Inks, typewriter ribbons, and carbon paper (2d ed.). Price, 10 cents.

C199. Specification for hand-operated grain hopper scales. Price, 10 cents.

C203. Recommended specification for quicklime and hydrated lime for use in the manufacture of calcium arsenate. Price, 5 cents.

C114. United States Government master specification for—
Cotton rubber-lined fire hose (couplings and gaskets). (2d ed.) Price, 5 cents.

C115. Pneumatic tires, solid tires, and inner tubes. (2d ed.) Price, 5 cents.

C201. Quicklime for structural purposes. Price, 5 cents.

C202. Vitrified chinaware. Price, 5 cents.

C204. Hydrated lime for structural purposes. Price, 5 cents.

C205. Gypsum plaster. Price, 5 cents.

C206. Calcined gypsum. Price, 5 cents.

C208. Wire rope. Price, 15 cents.

C209. Oil suction and discharge hose. Price, 5 cents.

C211. Gypsum wall board. Price, 5 cents.

C212. Upholstery leather. Price, 5 cents.

C213. Lace leather. Price, 5 cents.

C214. Medium and light rust-preventive compounds. Price, 5 cents.

C215. Outside white titanium-zinc paint, semipaste and ready mixed. Price, 5 cents.

C216. Putty. Price, 5 cents.

Miscellaneous Papers

M61. Report of the National Screw Thread Commission (revised, 1924). Price, 35 cents.

Simplified Practice Recommendations

Elimination of waste—

R26. Steel reinforcing bars. Price, 5 cents.

R27. Cotton duck. Price, 5 cents.

R31. Loaded paper shot shells. Price, 5 cents.

R35. Steel lockers (single and double tier). Price, 5 cents.

Special Publications

Report of the Building Code Committee—Minimum live loads allowable for use in design of buildings. Price, 10 cents.

These publications can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices given above. Do not send stamps.

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1925